

Before the  
FEDERAL COMMUNICATIONS COMMISSION  
WASHINGTON, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION  
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In the Matter of

Amendment of Parts 2 and 25 of the  
Commission's Rules to Permit Operation  
of NGSO FSS Systems Co-Frequency with  
GSO and Terrestrial Systems in the Ku-Band  
and

Amendment of the Commission's Rules  
to Authorize Subsidiary Terrestrial Use  
of the 12.2-12.7 GHz Band by Direct  
Broadcast Satellite Licensees and Their  
Affiliates

ET Docket No. 98-206  
RM-9147  
RM-9245

REPLY COMMENTS OF SKYBRIDGE

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## TABLE OF CONTENTS

	Page
TABLE OF CONTENTS . . . . .	i
SUMMARY . . . . .	v
I. INTRODUCTION . . . . .	3
A. Advancing the Public Interest . . . . .	3
B. Progress Toward Technical Consensus . . . . .	4
II. NGSO FSS Ku-BAND FREQUENCY ALLOCATIONS . . . . .	8
A. 13.75-14.0 GHz . . . . .	8
1. Application of S5.502 and S5.503 to NGSO FSS Gateways . . . . .	8
2. NGSO FSS Gateway Sharing with Radiolocation . . . . .	9
3. NGSO FSS Gateway Sharing with TDRSS . . . . .	9
B. 17.3-17.8 GHz . . . . .	10
1. NGSO FSS Gateway Sharing with Radiolocation . . . . .	10
2. NGSO FSS Gateway Sharing with BSS . . . . .	11
C. Gateways vs. Service Link Operations . . . . .	12
1. User Terminal Operation in the 14.4 - 14.5 GHz Band . . . . .	12
2. Gateway Operation in 11.7-12.7 and 14.0-14.5 GHz Bands . . . . .	12
D. NG 104 . . . . .	12
III. NGSO FSS SHARING WITH GSO FSS . . . . .	13
A. Results of ITU-R Studies . . . . .	13
1. Protection Criteria and Methodologies . . . . .	13
2. Aggregate Impact of Multiple NGSO Systems . . . . .	15
3. Maximum Number of Co-Frequency NGSO Systems . . . . .	16
4. GSO Links to be Used to Confirm Adequacy of Limits . . . . .	19
B. EPFD Limits . . . . .	21

C.	Undue Constraints . . . . .	26
D.	EPFD <sub>up</sub> Limits . . . . .	28
1.	Definition . . . . .	28
2.	Reference GSO Satellite Antenna Pattern . . . . .	29
3.	Proposed EPFD <sub>up</sub> Limits . . . . .	29
E.	Other Considerations . . . . .	30
1.	Large GSO Earth Stations . . . . .	30
2.	Inclined-Orbit GSO Systems . . . . .	32
3.	GSO TT&C . . . . .	35
a.	Operational Orbit . . . . .	35
b.	Transfer Orbit . . . . .	36
c.	Emergency Situations . . . . .	36
4.	NGSO Failures . . . . .	36
IV.	NGSO FSS SHARING WITH GSO BSS . . . . .	37
A.	Results of ITU-R Studies . . . . .	37
B.	EPFD Limits . . . . .	38
C.	Other Considerations . . . . .	42
1.	Airborne BSS . . . . .	42
2.	Future BSS Systems . . . . .	43
3.	GSO TT&C . . . . .	44
V.	NGSO FSS SHARING WITH FS . . . . .	46
A.	Gateway Operation . . . . .	47
1.	Gateway Definition . . . . .	48
2.	Coordination of NGSO FSS Gateways and FS Stations . . . . .	50
a.	Coordination Procedures . . . . .	50
b.	Gateway Site Shielding . . . . .	55
3.	Gateway Siting Restrictions . . . . .	57
4.	Restrictions on Gateway Antenna Size or Number . . . . .	59
B.	NGSO Satellite PFD Limits . . . . .	61
VI.	NGSO FSS / NGSO FSS SHARING . . . . .	64
A.	Satellite Diversity . . . . .	64

1.	LEO/MEO Systems . . . . .	65
2.	QGSO Systems . . . . .	66
3.	"VGSO" Systems . . . . .	68
B.	Band Segmentation . . . . .	70
C.	Other Sharing Techniques . . . . .	70
VII.	NGSO FSS SERVICE RULES . . . . .	72
A.	Mitigation Techniques to Protect GSO Arc . . . . .	72
B.	Off-Axis EIRPs . . . . .	72
C.	NGSO FSS Earth Station Antenna Patterns . . . . .	73
D.	Confirming Compliance with EPFD Limits . . . . .	74
1.	JTG Software Tool . . . . .	74
a.	NGSO FSS System Characteristics to be Provided . . . . .	75
b.	GSO Reference Antenna Patterns . . . . .	76
2.	Other Compliance Verification Techniques . . . . .	76
E.	Emissions . . . . .	78
1.	Emission and Frequency Tolerance Requirements . . . . .	78
2.	Protecting Radio Astronomy . . . . .	78
3.	RF Hazard . . . . .	79
VIII.	NGSO FSS LICENSING RULES . . . . .	81
A.	Mitigating Interference to other NGSO FSS Systems . . . . .	81
B.	Ensuring Service Goals . . . . .	81
1.	Coverage Requirements . . . . .	81
2.	Other Service Requirements . . . . .	83
C.	Ensuring Financial and Technical Capabilities . . . . .	84
D.	U.S. Processing Round . . . . .	86
1.	First Round . . . . .	86
2.	Later Rounds . . . . .	89

IX.	NORTHPOINT . . . . .	90
A.	Northpoint's Proposed Service . . . . .	91
1.	Northpoint's Promises to Supplement DBS Service with Local Channels are Illusory . . . . .	91
2.	Northpoint's Service is Not Novel, and Can be Provided in Other Bands . . . . .	92
3.	There is no Technical Reason Why Northpoint Should Operate in the 12.2-12.7 GHz Band . . . . .	93
B.	The Northpoint Technology . . . . .	96
C.	Sharing Between NGSO FSS and the Northpoint Service . . . . .	100
1.	NGSO FSS Systems Should Not Cause Interference to Northpoint Subscriber Antennas . . . . .	102
2.	Northpoint Will Cause Harmful Interference to NGSO FSS Subscriber Earth Stations . . . . .	104
D.	Sharing Between DBS and the Northpoint Service . . . . .	106
1.	Interference to DBS Receivers . . . . .	107
2.	Northpoint's Experimental Tests . . . . .	108
E.	There is No Basis for Licensing Northpoint-type Systems at Ku-band . . . . .	112
	CONCLUSION . . . . .	113

## SUMMARY

The instant rulemaking seeks to establish technical and other rules necessary to facilitate the licensing and operation at Ku-band of a new generation of global NGSO FSS systems, which are able to share spectrum with GSO FSS and BSS satellite systems and terrestrial FS operations. SkyBridge, in its initial comment in this proceeding, demonstrated that the introduction of NGSO FSS systems at Ku-band is technically feasible and will be instrumental in fulfilling the critical mission assigned to the Federal Communications Commission by Congress in Section 706 of the Telecommunications Act of 1996: ensuring access to high-speed, interactive broadband services for all Americans.

As described in SkyBridge's comments, WRC-97 authorized the sharing of spectrum in the Ku-band, and adopted technical parameters to prevent interference. Since then, various ITU study groups have been assessing the adequacy of the WRC-97 limits, and other candidate limits, to ensure that they do not pose undue constraints on the development of GSO and NGSO FSS, GSO BSS, and FS operations. This study group process is ongoing.

The efficacy of this process is perhaps best demonstrated by the fact that, in principle, no party to this proceeding opposes entry of NGSO FSS systems in the Ku-band. Obviously, the necessary technical rules must be finalized, but the record in this proceeding demonstrates that this can and will be accomplished. The initial comments demonstrate substantial faith in the process by all interested parties.

As noted by many commenters, significant progress has been made to date on practically every key issue, with a remarkable level of essentially universal

agreement. For example, general consensus has been reached within the ITU-R working groups on the GSO protection criteria and methodology to be used to assess candidate EPFD limits, the database of GSO links to be used in conjunction with this methodology, the principles of the software tool to be used for verification of compliance with the limits, and the values of the PFD limits for protection of the FS. SkyBridge agrees with the vast majority of the commenters that the Commission should give substantial deference to the results obtained in the ITU-R studies.

As SkyBridge explained in its comments, without the 13.75-13.8 GHz and 17.3-17.8 GHz bands, the allocation proposed by the Commission may be inadequate to support multiple, commercially viable NGSO FSS systems. SkyBridge demonstrated how NGSO FSS systems could operate in these bands without harming any of the U.S. government operations cited in the NPRM, or the BSS operations in 17.3-17.8 GHz band proposed to begin in 2007. As described in these reply comments, no party provided any reason why the SkyBridge proposals will not lead to harmonious sharing of these bands, and the Commission should proceed to add these bands to this NGSO FSS allocation.

With respect to sharing among NGSO gateways and FS systems, SkyBridge has proposed a comprehensive regulatory regime that will protect current FS operations and future expansion, without imposing unnecessary burdens on NGSO FSS systems. SkyBridge's proposals place significant constraints on NGSO FSS deployment and operation, yet SkyBridge believes that they represent a reasoned -- and unprecedented -- accommodation to the FS industry. In contrast, the Fixed Wireless Communications Coalition in its comments simply compiled a "laundry list"

of demands, none of which are supported by any demonstration that they will actually achieve their stated objectives or that they are even necessary to protect legitimate FS interests. The Commission should not succumb to the Coalitions's simple but arbitrary proposals, but instead should strive to implement a well-reasoned set of ground rules that optimize the use of the bands for both services.

As described in SkyBridge's initial comments, the Commission should impose service requirements on NGSO systems to ensure that each system furthers the fundamental international and domestic objective of universal access to competing broadband NGSO FSS systems that offer high-speed interactive services on a global basis. To permit multiple entry, the capability to employ satellite diversity to mitigate interference to other NGSO systems must be viewed as an essential qualification to be met by all Ku-band NGSO FSS applicants. Moreover, applicants should be required to demonstrate that their proposed system will: (1) provide global coverage; (2) offer a full range of high-speed broadband services; (3) provide full two-way interactive capability; and (4) offer direct access to the system for residential and business customers via low-cost ground terminals.

SkyBridge also urges the Commission to adopt the financial qualifications standards and various technical standards proposed in the NPRM, which have been used for other NGSO processing rounds, and apply them in the strictest fashion. As several parties emphasized, it will be impossible to move forward with the NGSO FSS Ku-band processing round unless all parties are ready, willing and able to proceed. Analysis of how the various applicants can best coexist must start immediately, and should involve only those applicants that can credibly demonstrate



the wherewithal to fulfill their proposals on an expeditious basis. Moreover, the Commission must ensure that any negotiations are governed by ground rules that prevent parties from stalling the process for anticompetitive or other reasons.

SkyBridge commends the Commission for issuance of a Public Notice regarding the acceptability for filing of the pending Ku-band NGSO FSS applications. As soon as possible, and in parallel, the Commission should direct all Ku-band NGSO FSS applicants to initiate technical discussions, formulate the NGSO FSS licensee qualification and NGSO/NGSO sharing rules in a First Report and Order, and begin international coordination of these systems. The Commission should seek to issue licenses to these applicants by the close of 1999, conditioned on such licensees' ultimately complying with whatever final technical and service rules are adopted after WRC-2000. Finally, as soon after the conclusion of WRC-2000 as is practicable, the Commission should conclude this proceeding by adopting a Second Report and Order establishing the necessary technical regulations for NGSO FSS operating at Ku-band.

The final issue in this proceeding is Northpoint's proposal to permit operation of terrestrial transmitters in the 12.7-12.7 GHz band on a secondary basis to transmit video and data traffic related to the operation of DBS systems. The commenters in this proceeding are virtually unanimous in urging the Commission to deny this request. Although Northpoint originally justified its service as a supplement to DBS service, to be provided in affiliation with DBS licensees, no DBS licensee supports the Northpoint proposal. No party to this proceeding, except of course Northpoint, expressed any hope that Northpoint's system could, in any manner of

operation, avoid causing grievous interference to DBS and NGSO FSS licensees in the band. And Northpoint provided no credible evidence to the contrary.

Moreover, the public interest predicate for the Northpoint system is dubious at best. In the face of universal opposition from its purported beneficiaries -- the DBS licensees -- Northpoint has recast its service to enter the terrestrial wireless broadband access market and compete head-on with DBS licensees in the multichannel video programming distribution market. At this point, Northpoint's continued promise of a local channel supplement to DBS service is nothing but a transparent sham, offered in the hopes of circumventing the Commission's requirements (most notably, to avoid an auction) for access to the several bands of spectrum already allocated for terrestrial broadband and MVPD services.

Moreover, Northpoint's proposed service -- with or without the provision of local channels -- already is permitted under a number of different allocations. Northpoint's newest proposal is nothing more (and, as a one-way service, is substantially less) than Local Multipoint Distribution Service, Multichannel Multipoint Distribution Service, or Digital Electronic Message Service. The Commission has already allocated sufficient spectrum for these services, and there is no technical reason why Northpoint should not be required to operate in those bands. Without the cooperation of DBS licensees, Northpoint will have substantial difficulty obtaining the encoding and transmission equipment needed to transmit signals that can be decoded by off-the-shelf receivers. Further, even if Northpoint were somehow able to make use of the DBS receiver, Northpoint still would have to provide a separate low-noise block down converter. Northpoint can downconvert from other

frequencies just as easily as from the 12.2-12.7 GHz band, and it can do so without threatening critical DBS and NGSO FSS services.

As noted by several commenters, Northpoint's technical claims seem extraordinarily deficient, lacking any true understanding of the satellite services with which it proposes to share, and making glaring errors in its analytical and experimental analysis. All DBS providers have concurred with SkyBridge's assessment of the interference that would be caused to satellite services by Northpoint. As detailed in these comments, many of the defects in Northpoint's King Ranch experiments, pointed out by SkyBridge in April 1998, were still present in its recent Austin tests. Moreover, the specifications provided by Northpoint in its various filings are wildly inconsistent, and do not reflect a mature system design.

In its comments, Northpoint continues to claim that its technology requires more protection than the WRC-97 PFD limits provide. As SkyBridge pointed out in its comments, however, Northpoint has never offered a shred of justification for its rather extraordinary protection criteria. There is no valid reason for Northpoint to claim a more stringent protection criteria than point-to-point FS operators, which have accepted the WRC-97 PFD limits.

On the other hand, numerous commenters agree with SkyBridge that NGSO FSS (and DBS) systems will suffer significant interference from a Northpoint system. Sharing among ubiquitous satellite earth stations and high density point-to-multipoint terrestrial systems presents an intractable problem; the Commission has detailed the problems inherent in such proposals in multiple proceedings. It is undisputed that each Northpoint transmitter will create a region in which NGSO FSS

user terminals cannot operate. Moreover, based on information in Northpoint's comments, the size and number of the NGSO user terminal exclusion zones would be quite large, and exist in highly populated areas.

SkyBridge is sympathetic to the dilemma currently confronted by DBS consumers regarding reception of local broadcast signals. However, there are far better means for providing local service than the Northpoint system. Reintroducing terrestrial use into the band would run counter to the Commission's prior efforts to promote DBS, and its current efforts to introduce global broadband interactive services. NGSO FSS proponents have demonstrated to the satisfaction of the DBS industry that, with adequate technical limits, NGSO FSS and DBS systems can successfully share spectrum. Northpoint has failed to make such a showing, and its proposal must be rejected.

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of NGSO FSS Systems Co-Frequency with	)	RM-9147
GSO and Terrestrial Systems in the Ku-Band	)	RM-9245
and	)	
Amendment of the Commission's Rules	)	
to Authorize Subsidiary Terrestrial Use	)	
of the 12.2-12.7 GHz Band by Direct	)	
Broadcast Satellite Licensees and Their	)	
Affiliates	)	

To: The Commission

**REPLY COMMENTS OF SKYBRIDGE L.L.C.**

SkyBridge L.L.C. ("SkyBridge"), by its attorneys, hereby replies to the comments filed by various parties in response to the Commission's Notice of Proposed Rulemaking<sup>1/</sup> (the "NPRM") in the above-captioned matter.<sup>2/</sup>

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<sup>1/</sup> FCC 98-310, released November 24, 1998.

<sup>2/</sup> In addition to comments filed by SkyBridge (the "SkyBridge Comments"), comments were filed by the following parties: The Association of American Railroads ("AAR Comments"); The Association of Local Television Stations, Inc. ("ALTV Comments"); The Boeing Company ("Boeing Comments"); Comsearch ("Comsearch Comments"); Denali Telecom, L.L.C. ("Denali Comments"); DirecTV, Inc. ("DirecTV Comments"); EchoStar Communications Corporation ("EchoStar Comments"); Fixed Point-to-Point Communications Section, Wireless Communications Division of the Telecommunications Industry Association ("TIA Comments"); Fixed Wireless Communications Coalition ("FWCC Comments"); GE American Communications, Inc. ("GE Comments"); The Global VSAT Forum ("GVF Comments"); The Government of the Kingdom of Tonga ("Tonga Comments");

(continued...)

The NPRM was issued in part in response to a Petition for Rulemaking filed by SkyBridge on July 3, 1997 (the "SkyBridge Petition"). The Petition was filed in conjunction with SkyBridge's application to the Commission (the "SkyBridge Application") for authority to launch and operate the "SkyBridge System," a global network of nongeostationary orbit ("NGSO") communications satellites operating at Ku-band, designed to provide broadband services in the Fixed-Satellite Service ("FSS").<sup>3/</sup>

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<sup>2/</sup>

(...continued)

Comments"); Home Box Office and Turner Broadcasting System, Inc. ("HBO Comments"); Hughes Communications, Inc. ("Hughes Comments"); Loral Space & Communications Ltd. ("Loral Comments"); The National Academy of Sciences' Committee on Radio Frequencies ("NAS Comments"); The National Association of Broadcasters ("NAB Comments"); Northpoint Technology, Ltd. ("Northpoint Comments"); OpTel, Inc. ("OpTel Comments"); PanAmSat Corporation ("PanAmSat Comments"); Petroleum Communications, Inc. ("PetroCom Comments"); Qualcomm Incorporated ("Qualcomm Comments"); The Satellite Broadcasting and Communications Association ("SBCA Comments"); The Satellite Coalition ("Satellite Coalition Comments"); The Society of Broadcast Engineers, Incorporated ("SBE Comments"); SBC Communications, Inc. ("SBC Comments"); Sullivan Telecommunications Associates ("STA Comments"); Teledesic LLC ("Teledesic Comments"); Telesat Canada ("Telesat Comments"); United States Satellite Broadcasting Company, Inc. ("USSB Comments"); and Virtual Geosatellite, LLC ("Virgo Comments").

<sup>3/</sup>

Application of SkyBridge L.L.C. for Authority to Launch and Operate a Global Network of Low Earth Orbit Communications Satellites Providing Broadband Services in the Fixed-Satellite Service, File No. 48-SAT-P/LA-97, filed February 28, 1997; Amendment, File No. 89-SAT-AMEND-97, filed July 3, 1997 ("1997 Amendment"); Amendment, 130-SAT-AMEND-98, filed June 30, 1998 ("1998 Amendment"); Public Notice, Report No. SPB-141 (Nov. 2, 1998); Amendment, filed January 8, 1999 ("1999 Amendment"); Public Notice, Report No. SAT-00013 (March 23, 1999).

## I. INTRODUCTION

### A. Advancing the Public Interest

The instant rulemaking seeks to establish technical and other rules necessary to facilitate the operation of a new generation of global NGSO FSS systems at Ku-band, which are able to share spectrum with geostationary orbit ("GSO") Fixed-Satellite Service ("FSS") and Broadcasting-Satellite Service ("BSS") satellite systems and terrestrial Fixed Service ("FS") operations. In its initial comment in this proceeding, SkyBridge demonstrated that such systems will be instrumental in fulfilling the critical mission assigned to the Commission by Congress in Section 706 of the Telecommunications Act of 1996 (the "'96 Act"): ensuring access to high-speed, interactive broadband services to all Americans.<sup>4/</sup>

While the Commission's Section 706 Report<sup>5/</sup> focused primarily on how best to ensure access for rural Americans to new broadband services -- and concluded that the only likely means of providing those critical services will be satellite systems, and most particularly, low earth orbit ("LEO") satellite systems<sup>6/</sup> -- it is the global reach of systems such as SkyBridge that will maximize the benefits of these services for all Americans. As the Commission stated in its Section 706 Report, "[w]idespread access to broadband capability can increase our nation's productivity and create jobs. Access to broadband can also meaningfully improve our educational,

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<sup>4/</sup> Pub. L. No. 104-104, 110 Stat. 56 (1996).

<sup>5/</sup> Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, FCC 99-5, released February 2, 1999 ("Section 706 Report").

<sup>6/</sup> Id. at 28, nn.110-111.

social and health care services."<sup>7/</sup> By ensuring that not only all Americans, but all citizens of the world, have access to these services, the public interest will be greatly served. U.S. Internet-based businesses can serve a global customer base, while U.S. consumers will have at their fingertips a global cornucopia of information, goods and services.

The establishment of appropriate technical rules for Ku-band NGSO FSS systems in the instant proceeding -- and the licensing of those systems -- represents the most effective means at the Commission's disposal for achieving these critical domestic and international goals of competitive, universally available access to high-speed, interactive broadband services.

#### **B. Progress Toward Technical Consensus**

As described in the SkyBridge Comments, the 1997 World Radiocommunication Conference ("WRC-97") authorized the sharing of spectrum in the Ku-band, and adopted technical parameters to prevent interference.<sup>8/</sup> WRC-97 directed that relevant bodies of the International Telecommunications Union ("ITU") study these parameters so that their values may be confirmed or modified as needed at

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<sup>7/</sup> Section 706 Report at 3-4.

<sup>8/</sup> As discussed in greater detail in the SkyBridge Comments, WRC-97 established an international regulatory regime for NGSO/GSO and NGSO/FS sharing, contained in Articles S21 and S22 of the ITU Radio Regulations. The core rules adopted at WRC-97 are "equivalent" power flux-density ("EPFD") and "aggregate" power flux-density ("APFD") limits applicable to NGSO FSS systems, and power flux-density ("PFD") limits applicable to each satellite in an NGSO FSS system. The values of the EPFD, APFD and PFD limits are to be reviewed at WRC-2000.



the next WRC, now scheduled for the spring of 2000 ("WRC-2000").<sup>9/</sup> The ITU study groups have been conducting the necessary assessment of the adequacy of the WRC-97 limits, and other candidate limits, to ensure that they do not pose undue constraints on the development of GSO and NGSO FSS, GSO BSS, and FS operations. This is an ongoing process.

The efficacy of this process is perhaps best demonstrated by the fact that, in principle, no party opposes entry of NGSO FSS systems in the Ku-band. Obviously, the necessary technical rules must be finalized,<sup>10/</sup> but the record in this proceeding demonstrates that this can and will be accomplished.<sup>11/</sup> The initial comments demonstrate substantial faith in the process by all interested parties, and SkyBridge agrees with the vast majority of the commenters that the Commission should give significant deference to the results obtained in the ITU-R studies.<sup>12/</sup>

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<sup>9/</sup> WRC-97 established an international task group -- Joint Task Group 4-9-11 ("JTG 4-9-11") -- to undertake these studies and report its findings to WRC-2000. Several other ITU-R bodies have also contributed to this effort, including Working Party 4A ("WP 4A"), Joint Working Party 10-11S ("JWP 10-11S"), Working Party 4-9S ("WP 4-9S") and Working Party 9A ("WP 9A"). WP 4A and JWP 10-11S have studied issues relating to NGSO FSS sharing with GSO FSS and GSO BSS, respectively. WP 4-9S and WP 9A have studied NGSO FSS sharing with FS and other terrestrial services. JTG 4-9-11 has conducted three meetings to date -- March 1998 in Geneva, July 1998 in Toulouse, and January 1999 in Long Beach. The final JTG meeting is scheduled for May 1999.

<sup>10/</sup> See, e.g., PanAmSat Comments at 1; GE Comments at 4; EchoStar Comments at ii, 3; GVF Comments at 2.

<sup>11/</sup> See STA Comments at 3.

<sup>12/</sup> See, e.g., Satellite Coalition Comments at 2; Loral Comments at i; Boeing Comments at 9, 44.

As noted by many commenters, significant progress has been made to date on practically every key issue, with a remarkable level of essentially universal agreement. For example, general consensus has been reached within the ITU-R working groups on the following issues:

- The GSO protection criteria and methodology to be used to assess candidate EPFD limits;
- The database of GSO links to be used in conjunction with this methodology;
- The use of continuous EPFD masks instead of discrete limits;
- The appropriateness of basing studies on the assumption of 3-5 non-homogeneous NGSO systems;
- The phenomena governing aggregation of interference of multiple NGSO systems;
- The EPFD<sub>up</sub> definition and value;
- The measures to protect GSO TT&C;
- The principles of the software tool to be used for verification of compliance with the EPFD and EPFD<sub>up</sub> limits;
- The values of the PFD limits for protection of FS; and
- The use of coordination to facilitate sharing between NGSO FSS gateways and FS stations.

Although important details remain to be worked out at the international level,<sup>13/</sup> it is clear that this will be accomplished in due course. In the interim, the Commission should proceed to establish the necessary frequency allocations and conclude the licensing process at the earliest possible date, leaving adoption of the

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<sup>13/</sup> As noted by one commenter, it would be over-optimistic to believe that the initial comments and replies in this proceeding will yield convergence on all of the appropriate spectrum sharing criteria. STA Comments at 4.

final technical rules until shortly after WRC-2000. In this way, the Commission can ensure the earliest possible deployment of these systems that are so critical to achieving the goal of Section 706.

## II. NGSO FSS Ku-BAND FREQUENCY ALLOCATIONS

As SkyBridge explained in its comments, without the 13.75-13.8 GHz and 17.3-17.8 GHz bands, the ability of the allocated spectrum to support multiple commercially-viable NGSO FSS systems is threatened. No party seriously disputed this point.<sup>14/</sup>

Furthermore, in its comments, SkyBridge made concrete and reasonable proposals that would allow NGSO FSS operations to operate in these bands without harming any of the U.S. government operations cited in the NPRM, or the BSS operations in 17.3-17.8 GHz band proposed to begin in 2007. As described below, no party provided any reason why the SkyBridge proposals will not lead to harmonious sharing of these bands, and the Commission should proceed to implement these proposals in its rules.

### A. 13.75-14.0 GHz

#### 1. Application of S5.502 and S5.503 to NGSO FSS Gateways

As explained in the SkyBridge Comments, certain modifications to international and domestic footnotes S5.502 and S5.503, as applied to NGSO FSS systems, will lead to more efficient sharing of the 13.75-14.0 GHz band. The changes proposed by SkyBridge will maintain the delicate balance currently in place. Importantly, SkyBridge proposes no change to the antenna size requirement governing these bands.<sup>15/</sup> The sole change proposed by SkyBridge would permit NGSO FSS

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<sup>14/</sup> One party, SBC, merely stated that it is "unconvinced" that NGSO services need all of the bandwidth requested. SBC Comments at 5. SBC provided no basis for its concern, however.

<sup>15/</sup> See GE Comments at 25.

systems to operate at a lower power than permitted under S5.502, so long as protection from the Radiolocation service is not claimed for such emissions.<sup>16/</sup> Such a rule would not harm Radiolocation in any way, and would facilitate sharing with NASA's Tracking Data and Relay Satellite System ("TDRSS").

## **2. NGSO FSS Gateway Sharing with Radiolocation**

SkyBridge described in its comments the operational characteristics of NGSO FSS systems that allow them to coexist with Radiolocation radars in the 13.75-14.0 GHz band, without a reduction in quality of service, and without any burden on the radar operators. No party disputed the ability of NGSO FSS and Radiolocation systems to share this spectrum.

## **3. NGSO FSS Gateway Sharing with TDRSS**

SkyBridge demonstrated in its comments that the SkyBridge System will fully protect the TDRSS system within its system requirements, as specified in Recommendation ITU-R SA 1155, even if its proposed revision to S5.502 is not implemented.<sup>17/</sup> Furthermore, SkyBridge explained how TDRSS could be protected from the aggregate interference from multiple NGSO systems. Therefore, the

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<sup>16/</sup> Specifically, SkyBridge proposed that until such time as footnote S5.502 of the ITU Radio Regulations is modified, the Commission take the simple step of adding a footnote to the U.S. Table of Allocations (and make conforming changes in Part 25) as follows:

US [#] In the frequency band 13.75-14.0 GHz, the e.i.r.p. of any emission from an earth station to a non-geostationary satellite in the fixed-satellite service may be less than the minimum value (68 dBW) specified in S5.502 of this table of allocations; however, any such emission with an e.i.r.p. of less than 68 dBW shall not be entitled to claim protection from operations in the radiolocation service.

<sup>17/</sup> See SkyBridge Comments at 13 and Appendix E.

Commission should conform its NGSO FSS allocations to those adopted internationally by the ITU at WRC-97, which include the 13.75-13.8 GHz band. In order to protect the TDRSS system, the Commission should apply footnote US 337 in the U.S. Table of Allocations to NGSO FSS systems, requiring such systems to coordinate on a case-by-case basis through the Frequency Assignment Subcommittee of the Interdepartmental Radio Advisory Committee to minimize harmful interference to TDRSS downlinks. This will ensure that only those systems able to protect TDRSS operations will enter the 13.75-13.8 GHz band.

**B. 17.3-17.8 GHz**

**1. NGSO FSS Gateway Sharing with Radiolocation**

In its comments, SkyBridge also explained how NGSO FSS gateway operations can coexist with the high-power radars in the 17.3-17.8 GHz band that track space objects. Specifically, SkyBridge proposed that operational coordination take place between the NGSO FSS systems and the Radiolocation operators to avoid prolonged exposure by NGSO satellites to the radar beams. Furthermore, although Radiolocation is secondary in this band, SkyBridge proposed a footnote in the U.S. Table of Allocations, similar in concept to S5.502, that would specify the "rules of the road" for shared use of this band by NGSO FSS and Radiolocation systems based on a definition of the interference environment. Such a footnote would thereby preclude NGSO FSS systems from claiming protection from the high power government Radiolocation radars in this band, so long as both systems are operating within the requirements of the footnote.

No commenter disputed the ability of NGSO FSS systems to co-exist with Radiolocation in the 17.3-17.8 GHz band. With the reasonable procedures proposed by SkyBridge to accommodate the concerns of the government radar operators, SkyBridge urges the Commission to permit NGSO FSS/Radiolocation sharing in this band.

## **2. NGSO FSS Gateway Sharing with BSS**

As described in the SkyBridge Comments, the Commission has proposed to allocate the 17.3-17.8 GHz band to BSS, starting in April, 2007. Although SkyBridge has strongly opposed, and continues to oppose,<sup>18/</sup> a premature allocation of this band to BSS, SkyBridge believes that, with cooperation between NGSO FSS and BSS operators, reverse-band sharing in this band is feasible, without an undue burden to either party. The cooperative measures cited by SkyBridge in its comments -- including restrictions on gateway function and possible shielding obligations on the NGSO FSS operator -- will ensure that separation distances will be small, and affect only a few sites, remote from heavily populated areas.

The parties that oppose sharing in this band, DirecTV and EchoStar, apparently did not take into account any such measures in reaching their conclusions regarding the feasibility of sharing.<sup>19/</sup> SkyBridge urges the Commission to refrain from any hasty decisions regarding use of this band, and allow the studies of this issue currently taking place in the ITU-R study groups to mature. SkyBridge is confident that the initial conclusions of the JTG -- that sharing appears feasible if the

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<sup>18/</sup> See SkyBridge Comments at 18, n.46.

<sup>19/</sup> See DirecTV Comments at 11-13; EchoStar Comments at 6.

number of NGSO FSS gateways are few -- will lead to a definite recognition of the compatibility of BSS and NGSO FSS gateways, when the cooperative measures SkyBridge is proposing are taken into account.

**C. Gateways vs. Service Link Operations**

**1. User Terminal Operation in the 14.4 - 14.5 GHz Band**

SkyBridge urged that user terminals be permitted in the 14.4-14.5 GHz band. Several parties agreed with this assessment,<sup>20/</sup> and no party opposed. Therefore, the Commission should permit user terminal operation in this band.

**2. Gateway Operation in 11.7-12.7 and 14.0-14.5 GHz Bands**

SkyBridge also proposed that gateway operations should be permitted in the nominal service link bands (11.7-12.7 GHz and 14.0-14.5 GHz bands).<sup>21/</sup> No party had a firm objection to this proposal. Boeing stated that it is examining whether this will make NGSO/NGSO sharing more difficult.<sup>22/</sup> SkyBridge believes that it will not, as the gateways have very good antenna discrimination.

**D. NG 104**

The Commission's proposal to amend footnote NG 104 to permit domestic NGSO FSS systems to operate in the 10.7-11.7 GHz and 12.75-13.25 GHz bands stands unopposed,<sup>23/</sup> and should be adopted.

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<sup>20/</sup> Boeing Comments at 41; Virgo Comments at 15; Loral Comments at 10.

<sup>21/</sup> Loral also supported the Commission's proposal to permit gateway operations in the 14.2-14.4 GHz band. Loral Comments at 14.

<sup>22/</sup> Boeing Comments at 51.

<sup>23/</sup> See Boeing Comments at 83 (supporting Commission's proposal).



### **III. NGSO FSS SHARING WITH GSO FSS**

A number of GSO FSS operators opposed the Commission's proposal to adopt the WRC-97 limits.<sup>24/</sup> Although there is no evidence that these limits would be inadequate to protect GSO systems, particularly taking into account the conservative assumptions described in the SkyBridge Comments,<sup>25/</sup> SkyBridge agrees with these parties that the ITU-R working groups have progressed significantly beyond the WRC-97 limits in a number of ways (such as use of continuous EPFD masks<sup>26/</sup>), and that the Commission's rules should benefit from the results of these studies.

#### **A. Results of ITU-R Studies**

##### **1. Protection Criteria and Methodologies**

As described in the SkyBridge Comments, the JTG 4-9-11 has agreed to use Preliminary Draft Revision to Recommendation ITU-R S.1323 as the basis for

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<sup>24/</sup> See Satellite Coalition Comments at 2-4; PanAmSat Comments at 2-8; Hughes Comments at 2; GE Comments at 5, 7 and GVF Comments at 3.

<sup>25/</sup> See SkyBridge Comments at 36. PanAmSat claims to have conclusively demonstrated that the provisional limits are not adequate in dry regions. PanAmSat Comments at 2, 5-6. As discussed further below, however, PanAmSat had to depart from the CR 92 database of links, and craft its own hypothetical links designed to be extraordinarily sensitive, to show such a result. Only under the most extreme circumstances would the WRC-97 limits have an impact on GSO links. See SkyBridge Comments at 42.

<sup>26/</sup> See SkyBridge Comments at 32.

deriving and assessing the adequacy of candidate limits. As SkyBridge outlined in its comments, S.1323 recommends that all NGSO systems (in the aggregate) should:

- contribute at most 10% of the time allowances for the bit error rate ("BER") or carrier-to-noise ratio ("C/N") specified in the short-term performance objectives of the GSO network, and
- not lead to loss of synchronization in the GSO network more than once per  $x$  days (the value of  $x$  to be determined in further studies).<sup>27/</sup>

Although a variety of methods described in S.1323 are considered acceptable for deriving candidate limits, the JTG has specified a single methodology (denoted Methodology D or Procedure D) for assessing whether candidate limits meet the Recommendation S.1323 criterion for the GSO links under consideration.

Notwithstanding this progress, one party, Boeing, urges the Commission to adopt an Io/No methodology to calculate long term interference to a GSO FSS link.<sup>28/</sup> However, for over a year the JTG has studied proposed criteria for establishing interference limits. Based on these studies, the JTG decided, with full United States support, to use Recommendation ITU-R S.1323, which takes into account both long term and short term configurations. A principle objective of these studies was to use a generic approach that is not specific to any particular type of NGSO system. S.1323 meets this requirement, and leads to limits applicable to all types of systems. Boeing's eleventh-hour proposal would not.

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<sup>27/</sup> A few parties raised concerns about the occurrence of synchronization loss for GSO links employing large earth stations. See Section III.E.1 below. However, it must be kept in mind that S.1323 already contains a provision that ensures that this consideration is taken into account in deriving the EPFD limits. This provision should be further developed within the ITU-R process, so that sync loss can be evaluated on an objective basis.

<sup>28/</sup> Boeing Comments at 4, 13, 18-22.

## 2. Aggregate Impact of Multiple NGSO Systems

As SkyBridge explained in its comments, single entry limits, applicable to each NGSO FSS system, are required. GSO FSS operators agree, and urge the Commission to adopt such limits.<sup>29/</sup>

However, the GSO operators also note that, from a GSO perspective, it is the aggregate impact of all of the NGSO systems that is of concern.<sup>30/</sup> SkyBridge is sympathetic to this concern, which was the motivation behind the Long Beach agreement to work toward development of a regulatory regime that would ensure that the acceptable aggregate interference used as the basis for deriving the single entry limits would not be exceeded. The regime contemplated would permit NGSO systems to coordinate amongst themselves,<sup>31/</sup> while ensuring that the aggregate is still met. The Commission should allow the details of the coordination procedure to be finalized at the international level.

One party, GE Americom, argues that the single entry limits must be capable of being revised if the aggregate cap will be exceeded by the entry of

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<sup>29/</sup> PanAmSat Comments at 14, GE Comments at 16.

<sup>30/</sup> Satellite Coalition Comments at 5; PanAmSat Comments at 3, 6; GE Comments at iii.

One party, PanAmSat, also argues that the WRC-97 limits do not consider the impact of multiple NGSO satellites within a system. PanAmSat Comments at 6-7. PanAmSat's argument is completely irrational, given that PanAmSat surely understands by now that the EPFD concept aggregates the contributions from all of the satellites within each system (weighted by the GSO earth station discrimination), and that this was one of the key motivations for adopting the EPFD approach.

<sup>31/</sup> See Radio Regulations S9.12, which governs coordination between NGSO systems.

additional NGSO systems.<sup>32/</sup> The Commission must reject this proposal, for all the reasons the law disfavors retroactive application of rules. One of the main reasons for establishing single entry limits is to provide NGSO FSS system designers certainty as to the restrictions under which they will have to operate. These limitations cannot be subject to change. The international regime contemplated would allow new entrants to coordinate with existing systems to the extent possible while honoring the aggregate mask, but it cannot include any mechanism for decreasing the single entry mask governing the operation of the earlier systems.

### 3. Maximum Number of Co-Frequency NGSO Systems

In order to derive single entry masks from an aggregate mask, a number of co-frequency NGSO systems must be assumed.<sup>33/</sup> As described in the SkyBridge Comments, this has been among the most contentious of the issues faced by the JTG. This is because, until recently, the GSO community had every incentive to argue that the number will be large, in order to reduce the single entry value that each NGSO system will be required to meet. With the assurance provided by the Long Beach agreement on regulatory regime to protect against a violation of an aggregate mask, this incentive should be reduced. SkyBridge hopes that this agreement will allow the parties to look more objectively at the number of systems that can realistically share, considering constraints imposed by the need to protect

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<sup>32/</sup> GE Comments at 10, 12.

<sup>33/</sup> As SkyBridge described in its comments, the aggregation of interference varies depending on the percentage of time under consideration. Therefore, converting aggregate masks to single entry, and vice versa, must be performed on a zone-by-zone basis. Numerous parties cited the importance of taking the zones into consideration when converting limits. See e.g., Boeing Comments at 54-55; Loral Comments at 3; STA Comments at 9.

GSO systems, avoid co-frequency NGSO systems, and still provide an economically feasible service.

Studies suggest that "several (e.g., three) truly homogeneous NGSO FSS systems might be able to share frequencies," but that "the number of NGSO systems employing different orbital characteristics . . . would probably be smaller than the number of co-frequency systems that can share using homogeneous orbits."<sup>34/</sup> Given the reality of the systems proposed to-date, the JTG has agreed to consider only the situation of non-homogeneous orbits.

Based on these considerations, SkyBridge has concluded that assuming a number "N" of three, for the purpose of deriving single entry limits from an aggregate mask, is a fair yet conservative estimate.<sup>35/</sup> A number of commenters agree. Boeing states that it is beginning to realize that it may be technically difficult for more than three non-homogeneous systems to share.<sup>36/</sup> Focusing particularly on the need for systems to be commercially viable, Loral points out that the WP 4A studies indicate that NGSO/NGSO sharing considerations limit N to three.<sup>37/</sup> Sullivan Telecommunications Associates notes that ultimately the actual number of systems will be determined through the Commission licensing process, but in the interim, the

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<sup>34/</sup> Document 4A/TEMP/75 (Rev.1).

<sup>35/</sup> It is important to understand that the number N used in deriving the single entry mask does not preclude entry of more than N systems. Due to the worst case assumptions used in the derivations, the actual interference from 3 systems will be below that calculated, leaving "headroom" for additional systems.

<sup>36/</sup> Boeing Comments at 5, 53.

<sup>37/</sup> Loral Comments at 16.

Commission should assume  $N=3$ , which simulations indicate could adequately cover practical cases of 3 to 6 actual systems.<sup>38/</sup>

PanAmSat appears to propose a different approach, urging the Commission to simply allocate the aggregate limits among NGSO systems based on the first round US applicants, and any foreign systems. Each system's allocated share of the aggregate would be an express condition of its license.<sup>39/</sup> It is not clear from PanAmSat's comments the basis upon which such an allocation would be achieved. Allocation of the aggregate should be based on the actual number of systems that can feasibly share, not on the arbitrary number of potential operators that applied. Nor is it clear how such an approach could be applied to foreign systems. Furthermore, the coordination between NGSO systems will involve assessment of a number of characteristics of each system. Testing all combinations of all possible radio parameters of all applicants, without having first limited the envelope of each system, would lead to a never-ending proceeding. In any case, defining a single EPFD mask that can be met by several NGSO systems, based on  $N=3$ , will leave room for other systems within the aggregate, and will not a priori eliminate the ability to license any particular system.

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<sup>38/</sup> STA Comments at 9.

<sup>39/</sup> PanAmSat Comments at 13-14.

#### 4. GSO Links to be Used to Confirm Adequacy of Limits

The JTG has agreed to use the database of "Annex 2" data it has compiled to assess the adequacy of candidate limits.<sup>40/</sup> As the Satellite Coalition urges, this will ensure that current and planned GSO operations are taken into account.<sup>41/</sup> It will also take into account the need to protect U.S.-licensed operations worldwide, as requested by PanAmSat.<sup>42/</sup>

Despite international agreement on this point, however, PanAmSat continues to insist that the approach taken in its parametric analysis, described in Document 4-9-11/342, be used for establishing EPFD limits.<sup>43/</sup> As noted by Boeing, PanAmSat is seeking protection for poorly designed "paper" links that would exist in high altitude, desert regions where interference from factors such as rain is so low that a 10% increase in unavailability would equate to almost no additional interference at all.<sup>44/</sup>

PanAmSat's approach suffers a number of flaws, and for this reason has been thoroughly rejected by the international study groups for the purpose of establishing EPFD limits. First, it is not based on assessment of actual designed links. By moving a single generic link around the world, a number of key considerations that affect actual links are ignored. No account is taken of the

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<sup>40/</sup> See SkyBridge Comments at 30.

<sup>41/</sup> Satellite Coalition Comments at 6.

<sup>42/</sup> PanAmSat Comments at 3, 16-17.

<sup>43/</sup> PanAmSat Comments at 2; see also GE Comments at 15.

<sup>44/</sup> Boeing Comments at 11.

individual interference environment (e.g., adjacent GSO satellites, FS buildout in the service region, and frequency re-use patterns) under which actual links operate.<sup>45/</sup> Moreover, the fact that beams serving dry regions generally also serve wet regions is ignored.

Second, PanAmSat's links are hypothetical. While SkyBridge agrees that existing and designed links should be taken into account, future links can easily be designed in accordance with the guidance provided by Rec. ITU-R S.1323.<sup>46/</sup> Failure to take such real-world considerations into account leads to undue constraints on NGSO systems, because it leads to greater restrictions (i.e., tighter EPFD limits) than necessary to protect actual GSO links. For this reason, PanAmSat's approach has been rejected at the international level, in favor of an approach that requires a detailed analysis of the impact of NGSO interference, under any set of candidate limits, on actual sensitive links. The Commission should follow the international lead in determining whether a set of proposed limits adequately protects GSO systems.

Finally, at this late stage, the Commission is faced with a new party, Qualcomm, which seeks to introduce new links that have never been examined by the international working groups (nor to SkyBridge's knowledge have they been introduced by the recent deadline for including links in the JTG database). However, Qualcomm's MSS OmniTRACS service operates on a secondary basis in the subject

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<sup>45/</sup> In addition, it is not clear that PanAmSat's generic links could continue to meet their objectives if additional GSO satellites, each contributing 6%  $\Delta T/T$ , were implemented in adjacent slots. Sound engineering practices dictate that such possibilities be into account in designing a link.

<sup>46/</sup> This consideration has been taken into account in the Ka-band context, because Ka-band GSO systems are not yet built.



FSS bands, and is not entitled to any protection. The Commission should dismiss Qualcomm's request that the Commission treat OmniTRACS as primary for the purpose of developing spectrum sharing criteria.<sup>47/</sup> Qualcomm conceded to secondary status to ease its efforts to obtain authorization to provide its mobile service in FSS bands; it should be estopped from now claiming greater priority than it agreed to in order to obtain a license. Although SkyBridge is confident that Qualcomm's system will in fact be protected by any of the EPFD limits currently under consideration (see Section III.B below), Qualcomm's eleventh-hour assertions are without merit.

#### **B. EPFD Limits**

In its comments, SkyBridge proposed single entry EPFD masks for 60 cm, 1.2 m, 3 m, 5 m, and 10 m GSO reference antennas,<sup>48/</sup> based on the CR 92 links in the database at the time. The limits proposed by SkyBridge will allow the overwhelming majority of GSO services, now and in the future, to continue growing and evolving unencumbered by NGSO FSS.

SkyBridge noted that its derivations will need to be revisited by SkyBridge once all of the relevant links have been provided. (As noted in the SkyBridge Comments, the deadline for providing links was March 15, 1999.) No other party appears concerned about taking the new links into account, including those parties that submitted the new links. Several GSO operators urged the Commission to

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<sup>47/</sup> Qualcomm Comments at 3.

<sup>48/</sup> EPFD limits for 1.2 m and 5 m antennas are not currently included in the Article S22 of the Radio Regulations. SkyBridge proposed adding masks for these antenna sizes to aid GSO system operators and designers.

adopt the limits hastily concocted and presented by the U.S. at the Long Beach JTG meeting.<sup>49/</sup> There has been no showing that these limits meet the Commission's dual goals of protecting GSO FSS systems, while avoiding unnecessary constraints on NGSO FSS systems.

These parties seem to believe that it is sufficient that some of the proposed NGSO FSS systems can meet all or most of these limits.<sup>50/</sup> This is hardly the criteria that the Commission should apply. The various NGSO FSS systems on file with the Commission employ a variety of designs to provide differing levels of service. Several of the systems touted as having the ability to meet more stringent limits operate at high altitudes,<sup>51/</sup> and will be unable to provide the level of interactivity that SkyBridge, through numerous market studies, has determined will be necessary to provide the level of service consumers are coming to expect.<sup>52/</sup>

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<sup>49/</sup> PanAmSat Comments at 2, 9-12; Hughes Comments at 2; GE Comments at iv, 10, 14, 19; GVF Comments at 2. Denali proposes limits it characterizes as "an acceptable compromise." Denali Comments at 9-10. However, these limits seem to be a composite of various limits submitted to the JTG, and do not appear to have undergone any Methodology D scrutiny.

<sup>50/</sup> See PanAmSat Comments at 2, 12-13; GE Comments at 11; GVF Comments at 3-4.

<sup>51/</sup> As shown by Boeing, for example, if NGSO systems are operated at very high altitudes, short term interference levels can be reduced while still providing global service (albeit with some reduction in potential capacity). Boeing Comments at 14, 17. However, such systems do not provide all the advantages of LEO systems, including low latency, which several NGSO proponents with actual business plans have deemed vital to providing broadband interactive services directly to consumers. See, e.g., <http://www.teledesic.com/tech/latency.html> (describing how latency can affect voice, as well as client/server and Internet protocols). QGSO and VGSO proposals suffer similar drawbacks. See Section VI.A below.

<sup>52/</sup> See also Section VI.A below. As noted in the Section 706 Report, at ¶ 50, (continued...)

Moreover, studies have shown that high altitude systems have more trouble sharing with other NGSO systems than LEO systems.<sup>53/</sup> With other systems, the level of analysis presented to date is simply insufficient to demonstrate that the systems will actually meet tighter limits, when all of the required worst-case considerations are taken into account, while still providing an economically viable service. The Commission must take a hard look at the proposals on the table, and force the proponents of such systems to do the same, before reaching any conclusions on the burdens to NGSO FSS systems of any set of proposed limits.

One party, Boeing, urges that the Commission should not tighten the long-term EPFD limits if the sole reason for such an adjustment is to enable a relaxation of short-term EPFD limits. Boeing asks the Commission to determine the appropriate limits for long-term and short-term independent of each other, to avoid penalizing parties that designed their systems to avoid causing short-term interference.<sup>54/</sup> While Boeing's specific proposal would clearly advantage its system at the expense of others, it raises an important point, i.e., the interference statistics of various NGSO systems differ, and the shape of statistics is not relevant to the GSO operators, so long as the 10% criterion is met on an aggregate basis.<sup>55/</sup>

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<sup>52/</sup> (...continued)  
n.111, satellite systems with significant latency are not suitable for all broadband applications.

<sup>53/</sup> See also Section VI.A.1 below.

<sup>54/</sup> Boeing Comments at 3-4, 12-14.

<sup>55/</sup> See, e.g., DirecTV Comments at 10.

To avoid the need to reach a compromise on the mask shape among the NGSO applicants, Boeing proposes that it may be appropriate to permit each NGSO licensee to develop its own EPFD limit mask that best represents the interference characteristics of its system. Each licensee would be required to operate within its allocated share of the overall 10% unavailability criterion.<sup>56/</sup>

Although this proposal would eliminate the problem of reaching agreement on a mask shape, it has a number of troubling aspects. Most importantly, if the 10% criterion, rather than an aggregate mask, is divided among NGSO systems, the links that have to be protected to test the 10% criterion must become part of the Commission's rules. New regulatory methodologies and software would have to be developed to ensure that each NGSO system's proposed mask, considered in connection with the "official" links, falls within its portion of the 10% criterion. Moreover, new studies would have to be undertaken to determine how the 10% criterion should be divided among systems. As discussed in the SkyBridge Comments, dividing an aggregate EPFD mask into single entry limits is not a simple matter of dividing by "N". It is unclear how the 10% criterion can be divided to properly take into account the way that NGSO interference aggregates. Although no model is perfect, the well-studied JTG approach of deriving an aggregate mask that protects GSO systems within the 10% criterion, and then using that mask to derive one single entry mask tailored to accommodate the interference statistics of the various types of proposed NGSO systems, should be followed.

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<sup>56/</sup> Boeing Comments at 15.

Qualcomm asks the Commission to adopt a  $-153.8 \text{ dBW/m}^2/4\text{kHz}$  EPFD limit, applicable 100% of the time, to protect OmniTRACS' mobile user antennas.<sup>57/</sup> However, Qualcomm ignores completely the methodologies adopted at the international level, and proceeds to derive limits: (1) without specifying any performance objective for its system; and (2) based on acceptance of a 6% noise temperature increase.<sup>58/</sup> Qualcomm's analysis is not based on assessment of the impact of NGSO interference on the OmniTRACS link performance, the fundamental principle governing the Rec. ITU-R S.1323 approach.<sup>59/</sup> A more detailed study of the link performance is needed to draw any conclusions on protection of the Qualcomm links. Even if Qualcomm were entitled to protection,<sup>60/</sup> such derivations should not be used by the Commission as the basis for any new limits.

Notwithstanding these considerations, SkyBridge is sympathetic to Qualcomm's concerns, and has engaged in discussions with Qualcomm in an effort to establish whether or not the OmniTRACS system will suffer harmful interference in practice. Based on its analysis to-date, SkyBridge is quite confident that the OmniTRACS system will in fact be compatible with NGSO FSS operation, without

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<sup>57/</sup> Qualcomm Comments at 3-4. Qualcomm says that, with such a limit, one NGSO system will not interfere with OmniTRACS. Qualcomm Comments at 3-4. Qualcomm states that the provisional EPFD limits will protect its hub earth stations. *Id.* at 5. Qualcomm also believes the provisional APFD will protect its satellite antennas. *Id.* at 5, n.7.

<sup>58/</sup> Qualcomm Technical Appendix at 1.

<sup>59/</sup> Moreover, S.1323 does not even apply a 6% criterion to NGSO systems; it is only used as a coordination trigger between adjacent GSO systems. And, it has no significance in the context of an MSS system.

<sup>60/</sup> See Section III.A.4 above. As a secondary mobile service in the bands, OmniTRACS is not entitled to protection.

any special regulatory conditions imposed. SkyBridge is willing to engage in any additional dialogue the Commission may deem useful to reassure Qualcomm and the Commission of this conclusion. However, SkyBridge will strongly oppose any movement to adopt limits or any other requirements based on protection of a secondary system.

### C. Undue Constraints

An important goal of this proceeding is to avoid unnecessary constraints on NGSO FSS systems. All NGSO FSS systems intended to co-exist with GSO systems incorporate design features to protect GSO arc operations. These features already impose substantial cost and capacity penalties on such systems. SkyBridge accepts its burden to protect GSO systems. However, a regime that over-protects such systems benefits no party, and represents an inefficient use of the spectrum. The Commission must strive to avoid such a result.

As SkyBridge described in its comments, the criteria and methodologies used to derive and assess EPFD limits are based on a number of extremely conservative assumptions.<sup>61/</sup> The cumulative effect of these assumptions means that

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<sup>61/</sup> In brief, these assumptions are as follows:

- The EPFD limits have to be met by each NGSO FSS system for any GSO earth station, no matter where in the world it is located, and no matter which direction it is pointed. The vast majority of GSO earth stations will receive far less interference than the EPFD limits would suggest.
  - Even for a GSO earth station at the worst case location and pointing direction, the maximum power will be experienced only during brief alignments of the NGSO satellite with the GSO satellite and earth station, and then only when the NGSO satellite is actually transmitting at maximum power through its higher sidelobes.
  - Even if a particular link does not appear protected under the Rec. ITU-
- (continued...)

GSO systems will be protected to a far greater degree than the analysis would imply. Only when all worst-case scenarios simultaneously converge for a given GSO earth station will the earth station actually experience the power levels permitted under Rec. ITU-R S.1323. SkyBridge urges the Commission to keep this in mind when considering the proposals of the various parties. As one party noted, reaching closure "will be facilitated by careful consideration of the error biases in the analyses used for establishment of frequency sharing criteria."<sup>62/</sup>

In reviewing the proposals, the Commission must also keep in the mind the impact on NGSO FSS systems of a tightening of the EPFD limits. As described in detail in the SkyBridge Comments, a tightening of the short term limits would require a corresponding reduction in the NGSO sidelobe PFD. This would require a tightening of the NGSO antenna pattern, or a decrease in the EIRP. A tightening of the long term limits would require either decreases in the satellite PFDs, or further

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<sup>61/</sup> (...continued)

R S.1323 criteria described above, the impact may be mitigated at the system level.

- In practice, an NGSO FSS system will not be able to generate exactly the same EPFD statistics as those defined by EPFD mask, but will generally operate below the mask.
- The Rec. ITU-R S.1323 methodologies reduce the number of fading sources that affect the GSO link, meaning that the impact of NGSO systems on actual GSO availability will be far below the 10% permitted.
- The software validation tool to assess compliance of an NGSO FSS system will provide an upper bound of the actual interference caused by the system, but it is this upper bound that must comply with the limits.

<sup>62/</sup> STA Comments at 2. STA noted in particular that the JTG tool introduces substantial error biases favoring overprotection of GSO systems, which should be taken into account in adopting limits to avoid constraining NGSO systems. STA Comments at 8.

avoidance of NGSO main beam to GSO sidelobe configurations. All such changes can substantially affect the cost and capacity of the NGSO system. As in the case of any serious satellite system proposal, the SkyBridge System was carefully designed in response to detailed market studies. Significant changes to cost and capacity can render a system economically unviable. If NGSO FSS services are to be provided in the Ku-band, such economic realities must be taken into account.

#### **D. EPFD<sub>up</sub> Limits**

##### **1. Definition**

The JTG 4-9-11 has tentatively agreed that it is appropriate to add a term to the APFD definition to take into account the GSO receive antenna directivity and to change the nomenclature from APFD to "EPFD<sub>up</sub>," which more accurately reflects the parameter being quantified. This result has been among the most uncontroversial at the JTG. Therefore it is not at all surprising that virtually all parties commenting on this issue strongly support the JTG decision, and urge the Commission to follow it.<sup>63/</sup>

What is surprising, however, is that, while acknowledging that the current definition overestimates the NGSO interference, PanAmSat argues that the current APFD definition should remain.<sup>64/</sup> PanAmSat provides no evidence whatsoever that the new, and overwhelmingly accepted, EPFD<sub>up</sub> definition will have any adverse impact on its links. The Commission should not credit such unsupported attempts to muddy the waters, and should follow the JTG lead on this issue.

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<sup>63/</sup> See, e.g., STA Comments at 5; Loral Comments at 8, Boeing Comments at 36, Virgo Comments at 13-14.

<sup>64/</sup> PanAmSat Comments at 16.



## 2. Reference GSO Satellite Antenna Pattern

The JTG has tentatively agreed to use the GSO antenna pattern in Recommendation ITU-R S.672, with a gain of 32.4 dBi, a sidelobe level of -20 dB, and a half-power beamwidth of 4°. All parties commenting on the pattern support this decision.

## 3. Proposed EPFD<sub>up</sub> Limits

As SkyBridge explained in its comments, the revised APFD definition does not in itself necessitate a change in the actual values of the WRC-97 provisional limits. Therefore, SkyBridge proposed the following EPFD<sub>up</sub> limits:

Frequency bands (GHz)	EPFD <sub>up</sub> (dBW/m <sup>2</sup> )	Percentage of time during which EPFD <sub>up</sub> level may not be exceeded	Reference bandwidth (kHz)	Reference antenna beamwidth and reference radiation pattern
12.75-13.25 13.75-14.5 17.3-17.8	-170*	100	4	32.4 dBi; 4 deg.; ITU-R S.672, Ls=-20

\* Except in the case of telecommand and ranging carriers transmitted to NGSO FSS satellites in the event of *force majeure*, which are exempt from these requirements.

All parties commenting on the EPFD<sub>up</sub> limits (except presumably PanAmSat), support this proposal.<sup>65/</sup>

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<sup>65/</sup> See Loral Comments at 8; Boeing Comments at 34, 37; Virgo Comments at 9, n.7, 14.

**E. Other Considerations**

**1. Large GSO Earth Stations**

SkyBridge agrees with the commenters that existing large earth stations should be protected from NGSO interference. However, this protection must be provided in a manner that does not unduly burden any party. As SkyBridge explained in its comments, such a result cannot be achieved without adequately taking into account the interference mechanisms; a narrowly-tailored approach is necessary to avoid overly-constraining NGSO systems.

First, the localization of the worst-case EPFD values is extremely pronounced, with a sharp drop off of several dB's in the worst-case EPFD for earth stations in areas immediately surrounding that location. This effect is magnified as the antenna size increases. As a result, the chance that a large earth station antenna will be sited in the worst-case location and pointed in the worst-case direction, and thus be susceptible to the worst-case EPFD, is truly insignificant. Moreover, the duration of short term events is very brief for large earth stations, decreasing as antenna size increases. Finally, many GSO systems using large dishes already take precautions against other causes of unavailability and sync loss (such as rain and sun outage), by employing site diversity for example.

Second, as described in the SkyBridge Comments, establishing a coordination regime can be fraught with difficulties. For these reasons, a coordination requirement should be imposed only in response to a definitive showing of harm to an identifiable class of large earth stations.

A number of commenters agreed with SkyBridge's assessment. STA pointed out that a coordination threshold cannot be determined until the EPFD limits are determined, because without the limits, it is impossible to determine whether or not a given class of earth stations is protected.<sup>66/</sup> Boeing and STA noted that special measures are not necessary with every large antenna of a given diameter; characteristics other than antenna size are important in determining whether an antenna is protected by the EPFD limits.<sup>67/</sup> Loral emphasized the importance of minimizing the number of instances where coordination is necessary, and echoed SkyBridge's concern that it is premature to set any antenna size (or gain) thresholds for coordination until studies are completed.<sup>68/</sup>

On the other hand, a few commenters ignored these considerations, and proceeded to propose antenna diameter thresholds to act as coordination triggers.<sup>69/</sup> The Commission should reject these unsupported proposals, and follow the lead of the ITU-R study groups in developing a more reasoned approach to assure protection of large earth stations.<sup>70/</sup>

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<sup>66/</sup> STA Comments at 7, n.10.

<sup>67/</sup> Boeing Comments at 23; STA Comments at 7. Boeing proposed a threshold based on exceeding  $I_o/N_o = 2\%$  at the location of the GSO earth station. Boeing Comments at 23-24. However, this criteria is three times lower than the static allowance from adjacent GSO systems, and is far lower than that required to prevent sync loss. Adopting such an extreme threshold would place undue burdens on NGSO systems.

<sup>68/</sup> Loral Comments at 5-6.

<sup>69/</sup> GE Americon proposed 15 meters, GE Comments at 22, while Telesat proposed 10 meters, Telesat Comments at 7. These proposals illustrate the danger of creating a slippery slope threatening the entire EPFD limit concept.

<sup>70/</sup> The JTG has undertaken the task of obtaining further information from  
(continued...)

As SkyBridge pledged in its comments, it will work within the ITU-R study groups and with the Commission to further assess the impact of NGSO FSS systems to large earth stations. If it is determined that a coordination procedure for certain large earth stations is required, SkyBridge will work to develop the appropriate procedure and triggers for such coordination.

Some parties expressed particular concern about the occurrence of synchronization loss by GSO systems employing large antennas.<sup>71/</sup> As noted above, Recommendation ITU-R S.1323 already includes a provision that, once finalized, will permit sync loss to be examined on an objective basis. In the meantime, however, no party has demonstrated that, when the localization of the worst-case EPFD and the very brief duration of short term events are taken into account, any actual system will be unreasonably burdened by sync loss.

## **2. Inclined-Orbit GSO Systems**

Under current Commission rules, licensees operating in inclined orbits may not claim any protection in excess of the protection that would be received in non-inclined orbit, and cannot cause more interference to adjacent satellites as a result

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<sup>70/</sup> (...continued)  
administrations on the use of large earth stations, and U.S. operators have already supplied detailed information to that group. PanAmSat's proposal that the Commission solicit additional comments on large earth station deployment in the Ku-band is therefore redundant. PanAmSat Comments at 23-24.

<sup>71/</sup> PanAmSat Comments at 22-23; Telesat Comments at 7. In particular, Telesat states that any incidence of sync loss under clear-sky conditions solely due to introduction of a new NGSO system is unacceptable. However, it must be kept in mind that sync loss can be caused by other factors, such as rain and sun outage. Systems that are especially sensitive to sync loss already take precautions to prevent sync loss, no matter what the cause.

of operating in an inclined orbit.<sup>72/</sup> From a regulatory standpoint, SkyBridge agrees with this approach, and urges the Commission to extend it to NGSO systems. However, SkyBridge also agrees with the commenters urging that inclined-orbit operations should not be imperiled by NGSO FSS systems.<sup>73/</sup> As discussed in SkyBridge's comments, NGSO systems that employ satellite diversity to avoid the GSO arc inherently provide significant protection to GSO satellite systems using slightly-inclined orbits. Studies on the degree of protection provided as a function of inclination angle are ongoing,<sup>74/</sup> but results to date indicate that reasonable protection is afforded, without any special regulatory constraints on NGSO systems.<sup>75/</sup>

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<sup>72/</sup> PanAmSat is incorrect in its assertion (see PanAmSat Comments at 18 n.30) that Section 25.280(b) grants to inclined-orbit satellites the same level of protection from interference as are granted to non-inclined-orbit satellites. Any increase in sensitivity to interference caused by placing the satellite in inclined orbit is at the risk of the operator of the inclined-orbit satellite.

<sup>73/</sup> See, e.g., Loral Comments at 6.

<sup>74/</sup> SkyBridge does not believe that the Commission must determine a degree of inclination to be accommodated for the purposes of these studies, as several parties suggest. See GE Comments at 23; Boeing Comments at 25, 35; Telesat Comments at 7. Moreover, SkyBridge agrees with Loral that it may not be appropriate or reasonable to accommodate the most sensitive or extreme inclined orbit operations to the same extent that most inclined orbit services are protected. The studies should take into account the nature of the services provided by the inclined-orbit systems. Loral Comments at 6-7.

<sup>75/</sup> As discussed by SkyBridge and Loral in their comments, JTG results indicate that, for SkyBridge-like systems, GSO receivers do not experience any significant increase in EPFD working with satellites with absolute inclinations of up to 3°, and that the EPFD increases by about 3 dB for satellites with an inclination of 5°. SkyBridge Comments at 52; Loral Comments at 6. Further studies are required to assess the impact of other NGSO architectures, but SkyBridge believes that, due to the arc avoidance employed by all such systems, the results are not likely to differ. (Although Boeing states that it has found that EPFD goes up for percentages of time less than 1% by 5 dB for 5° inclination for a 60 cm dish, Boeing Comments at 26, it must be kept in mind (continued...)